# Summaries

UDC 519.179.1

**Bykova V.V.**
**RECURRENCE METHODS OF COMPUTING HYPERGRAPH TREE WIDTH**

The NP-hard problem of finding hypergraph tree width has been considered. The polynomial-time recurrence methods of hypergraph pre-processing allowing reducing the size of this problem without losing optimality were proposed.

UDC 004.94

**Pogrebnoy V.K.**
**THE METHOD OF STRUCTURAL DIFFERENCE INTEGRATION IN GRAPH MODELS AND ITS APPLICATION FOR DESCRIBING STRUCTURES**

The problem of analyzing graph structures in order to estimate their similarity and detect difficult-to-locate properties has been considered. The methods of free and dependent integration of structural differences and obtaining integral structure descriptor (ISD) were proposed. The notion of difference integration area for the class of structures was introduced and the rules of its formation were developed. The proposed techniques formed the basis of a new technology of analyzing structures by ISD, called ISD-technology.

UDC 004.94

**Pogrebnoy V.K., Pogrebnoy D.V., Pogrebnoy An. V.**
**THE EQUATIONS OF THE DYNAMIC OF SML SYSTEM MODEL FUNCTIONING**

The parameters of the model and its state have been introduced for the dynamic model of real time distributed system introduced in SML language in the form of data flow graph. The recurrence equations describing in matrix form the dynamic of model functioning in discrete time were proposed. The functions of modules transition from one state to another were developed. The obtained results allow constructing in static the calculated paths of the model state change, analyzing them and optimizing model dynamic characteristics.

UDC 519.8

**Kiselev I.S.**
**INDEX OF QUANTITATIVE PREFERENCE CONSISTENCY IN PAIRWISE COMPARISON MATRIX**

The index of eigenvalue method of multiplicative matrix has been analyzed. It was shown that consistency index proposed by T. Saati goes beyond the normalization range for ill-consistent matrices. The consistency index of multiplicative matrices on the basis of eigenvalue method of entity triple was proposed.

UDC 681.51

**Balasanyan S.Sh.**
**STRATIFIED MODEL FOR ESTIMATING AND ANALYZING THE EFFICIENCY OF FUNCTIONING COMPLEX PROCESS SYSTEMS WITH MANY STATES**

The generalized stratified model for estimating and analyzing the efficiency of functioning of the complex process systems with many operational conditions, taking into account element reliability influence, has been proposed. It is shown that application of the proposed model as a formalization diagram, constructing simulation model of complex process system functioning, allows simplifying considerably and accelerating the system model construction providing the convenience of simulation experimentation. The proposed model application is demonstrated by the example of simulation of ore grinding manufacturing system.

UDC 519.7;519.81

**Kolesnikova S.I.**
**THE FEATURES OF APPLYING REFERENCE MODELS FOR MARKING TIME SERIES AT RECOGNITION OF COMPLEX OBJECT STATE**

The model for marking the stochastic time series with non-linear trend on the basis of algebraic approach to correct algorithm synthesis has been introduced. It is the development of problem-oriented synthesis theory of taught algorithm families with the required properties. Algorithm family of reference time series marking was obtained, its properties were studied on the basis of the model. The numerical simulation data were given.

UDC 519.673

**Khamukhin A.A.**
**MODIFICATION OF HOMOGENEOUS STRUCTURE CELL FOR SOLVING PARTIAL DIFFERENTIAL EQUATIONS WITH DEPENDENT COEFFICIENTS**

Modification of homogeneous structure cell for solving partial differential equations with coefficients depending on desired variable has been proposed. The possibility of implementing cell functional content with parallel conversion of coefficient magnitudes in the external device was shown. The results of cell line simulation were introduced by the example of solution of test boundary problem with temperature-dependent coefficients.

UDC 539.37+517.91

**Semenov M.E., Kolupaeva S.N.**
**THE ANALYSIS OF ADAMS AND GEAR METHODS EFFICIENCY AT SOLUTION STIFF SET OF DIFFERENTIAL EQUATIONS IN SPFCC PACKAGE**

The efficiency of using numerical Adams and Gear methods at solution stiff set of differential equations in SPFCC package has been analyzed. The approach allowing detecting the integration interval areas where numerical stability of the method places restrictions to inner integration step length was described.

UDC 004.932

**Solodushkin A.I., Kibitkin V.V., Pleshanov V.S.**
**MODIFIED COMPUTATION ALGORITHM OF DISPLACEMENT VECTOR FIELD FOR DEFORMATION ESTIMATION**

The modified computation algorithm of displacement vector field has been developed on the basis of a pair of images of the material surface allowing reducing computational complexity of information processing. The influence of algorithm input parameters on accuracy of finding displacement vector was examined.

UDC 004.62

**Sharabayko M.P., Osokin A.N.**
**FAST ALGORITHM OF FRACTAL IMAGE COMPRESSION**

The most efficient modifications of fractal image compression algorithm from the point of view of compression time decrease have been studied. The fast fractal compression algorithm using block classification, compression process parallelism, reodering block pixels in memory was synthesized on the basis of software implementation investigation. These modifications accelerate considerably the compression process (up to 1000 times in comparison with the basic one) preserving the size of a compressed file and having insignificant quality losses. The quadtree partitioning modification simplifies partitioning and work with nonsquare size images.

UDC 004

**Kermani Kolankekh A., Spitsyn V.G., Khamker F.**
**FINDING PARAMETERS AND REMOVING CONSTANT COMPONENT OF GABOR FILTER FOR IMAGE PROCESSING**

Software for designing Gabor filters has been developed for detecting object edges in the picture. The problems of finding optimal parameters and removing constant component of Gabor filter were solved.

UDC 004.931

**Bolotova Yu.A., Spitsyn V.G., Fomin A.E.**
**APPLICATION OF HIERARCHICAL TEMPORAL MEMORY MODEL IN IMAGE RECOGNITION**

The system for solving image recognition problem has been developed on the basis of hierarchical temporal memory model of J. Hawkins and G. Dileep. System structure, training and operating algorithm were described. The results of system testing were introduced by the example of styled numbers recognition.

UDC 004.931

**Druki A.A.**
**THE SYSTEM OF SEARCH, SEGREGATION AND RECOGNITION OF FACES IN THE PICTURES**

Convolutional neural networks have been used for solving the problem of face segregation and recognition. The structure of the developed neural network was introduced. The algorithm for image scaling and clustering was given.

UDC 004.932

**Fan Ngoc Hoang, Spitsyn V.G.**
**THE ANALYSIS OF ALGORITHMS FOR IMPULSE NOISE DETECTION IN DIGITAL PICTURES**

The methods of detecting impulse noise occurrence in digital pictures have been analyzed. The results of matching various algorithms for detecting pixels deformed by impulse noise were introduced.

UDC 004.932

**Buy Thi Thu Chang, Spitsyn V.G.**
**DIGITAL IMAGE DISSECTION BY TWO-DIMENSIONAL DISCRETE WAVELET TRANSFORM AND FAST HAAR WAVELET TRANSFORM**

The perspectives of applying two-dimensional discrete wavelet transform and fast Haar wavelet transform for digital image dissection have been considered. Formulas and results of applying fast Haar wavelet transform for digital image dissection were introduced.

UDC 004.9

**Tarkov M.S., Tikhonov N.V.**
**ESTIMATING IMAGE HETEROGENEITY ON THE BASIS OF THEIR REPRESENTATION BY QUADTREES**

The analysis of thermal images (thermograms) of man body surface shows the presence of relation between his body state and heterogeneity («mottling») of thermograms. The numerical estimation algorithm of image heterogeneity is proposed in this work. Image heterogeneity (inhomogeneity) is estimated by the quantity of quadtree leaves corresponding to image segments. Any segment is parted into four parts and certain leaves in a quadtree are generated if this segment satisfies certain heterogeneity criterion.

UDC 519.713

**Zhigulin M.V., Kolomeets A.V., Kushik N.G., Shabaldin A.V.**
**TESTING SOFTWARE IMPLEMENTATION OF IRC PROTOCOL BASED ON EXTENDED FINITE STATE MACHINE**

Testing the software implementation ngIRCd of IRC telecommunication protocol based on extended finite state machine has been considered. Computer experiments illustrate the efficiency of the proposed technique.

UDC 616.441:519.876

**Konstantinova L.I., Kochegurov A.I., Kochegurov V.A.**
**HIGHWAYS INFORMATION TECHNOLOGIES IN EVIDENTIARY MEDICINE PROBLEMS**

The problem of highway technology of observation results presentation has been discussed. The possibility of individualized approach to decision making in practical medicine problems is used in it. The substantiated choice of vector of indices characterizing properties of highways and methods of observation results reflection based on bionic models were discussed.

UDC 004.822:004.4

**Zaikin I.A., Tuzovskiy A.F., Yampolskiy V.Z.**
**THE COOPERATIVE SUPPORT SYSTEM OF ONTOLOGY MODELS**

The model of ontology lifecycle has been considered; the problems solved at each of its stage have been stated. The architecture of the system providing ontological model support at the stages of analysis of data domain, implementation, test, introduction and adjustment by several users was proposed; each of them can use ontology editor familiar for him. The variant of system implementation using OWL API, Pellet, RCO FactExtractor SDK and OpenLink Virtuoso components was proposed.

UDC 004.415;551.46;551.52;553.361

**Engel M.V., Afonin S.V., Belov V.V.**
**WEB-RESOURCE FOR ATMOSPHERIC CORRECTION OF SATELLITE DATA**

Web-resource allowing fulfilling remotely atmospheric correction of satellite measurements on the basis of physical approach has been described. Local and space-distributed information resources are used as information sources for assignment of optical-meteorological state of atmosphere. At the first stage the web-resource is oriented to processing satellite data of EOS/MODIS and NOAA.

UDC 002.53:004.89

**Zagorulko Yu. A., Borovikova O.I., Kononenko I.S.**
**PROVIDING CONTENT-BASED MULTI-LANGUAGE ASSESS TO LINGUISTIC INFORMATION RESOURCES ON THE BASIS OF KNOWLEDGE PORTAL TECHNOLOGIES**

Knowledge internet-portal providing systematization and integration of knowledge and information resources in computer linguistics on the basis of ontology has been considered. The content-based multilanguage assess: ontology-driven navigation and information search in terms of knowledge portal data domain was examined as well.

UDC 004.021

**Malakhov E.V., Zamyatina O.M.**
**IMPROVEMENT THE OSTIA ALGORITHM FOR LEARNING TRANSDUCERS**

The problem of learning transducers (two-band automata) on finite set of pairs specifying a chain of source language and the equivalent chain of target language has been considered by the example of OSTIA algorithm. The technique of using a set of chains, that do not exist in the source language, was proposed for decreasing improved errors of the OSTIA algorithm. The OSTIA algorithm was for providing correct translation of chains that do not exist in the the source language. A number of experiments was carried out. The advantage of the proposed technique in comparison with the basic version of OSTIA was shown.

UDC 681.51

**Sidorova A.A., Malyshenko A.M.**
**THE ANALYSIS OF THE EFFICIENCY OF AUTOMATED CONTROL ALGORITHMS OF ADAPTIVE INDUSTRIAL PID-CONTROLLERS**

It was supposed that automatically tuned adaptive PID-controller of the industrial purpose, developed in the Institute of control problems of RAS, Moscow, may be used at controlling dynamic processes with changing parameters and exposed by uncontrolled disturbances. It was ascertained that an error of PID-controller adaptation to object parameters change at control system operation varies in the range of 10 %. The conclusion was drawn on the efficiency of using this technique of adaptive tuning.

UDC 62–533.6

**Korovikov A.G., Pavlov V.M., Olkhovik D.A.**
**ALGORITHMIC SUPPORT OF CONTROL SUBSYSTEM OF HEATING TOKAMAK KTM VACUUM CHAMBER**

Two-circuit control algorithms of control subsystem of heating tokamak KTM vacuum chamber with local control level of and collective control in heating zones have been developed. The structure and content of control technology complex of heating tokamak KTM vacuum chamber were determined. Algorithms of gathering, recording and controlling energy supply parameters were developed. The possibility of carrying out steady heating modes as one of the stages of chamber vacuum preparation was shown.

UDC 66.012–52:004

**Borikov V.N., Baranov P.F.**
**A CONCEPT OF MEASUREMENT AND CONTROL SYSTEM FOR MICROPLASMA COATING FORMATION PROCESS**

A concept of automated measurement and control system for the microplasma coating formation process has been proposed. Modular construction of software was developed and described.

UDC 004.62:004.42

**Veyber V.V., Bogdan S.A., Kudinov A.V., Markov N.G.**
**A CONCEPT OF CONSTRUCTING A PLATFORM FOR INTEGRATING MANUFACTURING DATA OF OIL AND GAS COMPANY**

The problem of manufacturing data integration of oil and gas company was formalized in order to form a concept of integration based on principles of service-oriented architecture and accepted industrial standards of application integration.

UDC 665.6/.7;004.942

**Kravtsov A.V., Usheva N.V., Moizes O.E., Kuzmenko E.A., Reizlin V.I., Gavrikov A.A.**
**INFORMATIONAL-SIMULATING SYSTEM OF FIELD TREATMENT PROCESSES OF GAS AND GAS CONDENSATE**

Informational-simulating system of complex treatment of gas and gas condensate for computing unit material balances, studying the influence of technological parameters on output and quality of commercial gas, optimizing process conditions of industrial unit operation has been developed. The possibility of its practical application for selecting the most efficient modes of unit operation was shown by the example of Myldginskoe gas-condensate field of Tomsk region.

UDC 669.162.28

**Lavrov V.V., Spirin N.A., Burykin A.A., Krasnobaev A.V., Novikova N.V.**
**THE DEVELOPMENT OF FUNCTIONAL MODEL OF AUTOMATED INFORMATION SYSTEM OF ANALYZING AND FORECASTING BLAST FURNACE PLANT OPERATION**

Technological characteristics of applying the method of functional modeling IDEF0, used by the authors when developing the automated information system of analyzing and forecasting manufacturing situations at blast furnace plant in «Magnitogorsk steelworks» have been reflected.

UDC 621.87:621.865.8

**Scherbakov V.S., Korytov M.S.**
**THE TECHNIQUE OF PLANNING OBJECT TRAJECTORY IN THE MEDIUM WITH IRREGULARITIES ON THE BASIS OF MODIFIED ALGORITHM FOR PROBABILISTIC ROADMAP**

The modification of the algorithm for probabilistic roadmap has been described. It allows searching for optimal trajectory of free form load displacement by a hoisting machine in three-dimensional space with arbitrary irregularities specified in discrete form subject to load angular orientation.

UDC 004.021

**Savrasov F.V., Dyomin A.Yu.**
**OPTIMIZATION TECHNIQUES OF DYNAMIC FORMATION OF TRANSPORT ROUTE**

A concept of dynamic generation of passed route track on transport side has been considered. Communication channel types used in the systems of road transport monitoring were analyzed. The problems occurring at minimization of transmitted information from a vehicle to control center server are presented for consideration. The possibility of optimizing the technique for determining the predefined areas relative to which a vehicle may move was examined. The algorithm allowing defining navigation points, in which a vehicle movement direction vector changes, was proposed. The test results of the examined techniques in conditions of real work process were introduced.

UDC 658.512.23:004

**Dronov V.V., Kukhta M.S.**
**CERAMICS DESIGN BY SOFTWARE PLUG-IN AUTOMORPH**

Pre-requisites and conditions for automated generation of variants of solid-state computer models of industrial design have been indicated by the example of ceramics. The design project of ceramics computer model series obtained by application of automated generation by set-up parameters of a base model was introduced. The software plug-in AutoMorph was developed and introduced into production of stoneware. The results of machine generated process timing technique of a series of models were introduced. The assessment method for the models obtained by the automated technique on the basis of expert analysis method was proposed.

UDC 519.872

**Nazarov A.A., Ananina I.A.**
**MATHEMATICAL MODEL OF LIFE ANNUITY PROCEDURE**

Mathematical model of financial flows of the company, made life annuity contracts with people, has been developed in the form of queuing system with unlimited number of lines and phases of service. The investigation of this system flows applying a method of limiting decomposition allowed finally computing the appropriate value of annuity payment satisfying both sides of the contract.

UDC 519.872

**Nazarov A.A., Sudyko E.A.**
**THE CONDITIONS OF STEADY STATE EXISTENCE IN NON-MARKOV SYSTEMS WITH CONFLICTS OF REQUESTS**

Non-Markov system with conflicts of requests has been considered. Both requests pass to the source of repeated call at conflict occurrence. The imbedded Markov chain was constructed for the system state changing process. A type of function determining the conditions of Mustafa theorem on Markov chain ergodicity was found.

UDC 378.662.007 (571.16) (09)

**Malyshenko A.M., Gaivoronskiy S.A.**
**THE 50TH ANNIVERSARY OF AUTOMATICS AND COMPUTER TECHNOLOGY DEPARTMENT. STAGES OF A LONG WAY**

The 50-years history of establishment and development of automatics and computer technology department at Tomsk polytechnic university has been briefly described. It was the first in Asian part of our country that started training specialists in automatics, telemechanics, measurement and computer technology. Modern directions of training graduates and innovations in educational process, scientific work in the Institute of cybernetics at TPU, became a successor of the department from 2010, were enumerated.